Interventional Neuroradiology 10 (Suppl 1): 97-100, 2004

Stenting for Atherosclerotic Stenosis of the Intracranial or Skull Base Cerebral Arteries

Effectiveness and Problems

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Key words: intravascular neurosurgery, percutaneous transluminal angioplasty, stent, atherosclerotic stenosis, intracranial cerebral artery

Summary

Since May 1992, we have performed percutaneous transluminal angioplasty (PTA) or stenting 70 times for 65 lesions in 62 patients with atherosclerotic stenosis of the intracranial or skull base cerebral arteries. Stenting was carried out nine times for nine lesions in nine cases. Stenting was performed on patients with an average age of 62. The patients were eight men and one woman. The stenotic lesions involved the internal carotid artery (petrous portion) in four cases, the internal carotid artery (cavernous portion) in two cases, the internal carotid artery (supraclinoid portion) in one case, the middle cerebral artery (M1) in one case, and the vertebral artery (V4) in one case. The degree of stenosis ranged from 70% to 99%, with a mean of 80%. A stent for coronary arteries was used in all cases. After PTA was carried out in four cases, their initial extension was inadequate, and dissection was performed in five cases after PTA. As for the results of the treatment, subarachnoid haemorrhage occurred in one case due to perforation by the guidewire, and a major deficit was accepted. During the operation, asymptomatic cerebral infarction by distal embolism occurred in one case. Although obstruction of the lesion occurred three months after treatment in one case, symptoms did not appear. Stents used for atherosclerotic stenosis of the intracranial or skull base cerebral arteries still do not have sufficient performance. Although the stenting had problems, such as a prolonged patent, in the present condition, it was effective in terms of recovery from complications due to PTA.

Introduction

With the latest treatment equipment and progress in technique, intravascular surgery is applied as treatment for intracranial vascular stenosis, and has become an alternative treatment. Although PTA was mainly performed for intracranial vascular stenosis at first [2-5,8,10], vessel dissection and insufficient dilatation occurred with only PTA treatment. For this reason, a stent has recently been used for these problems [1,6,7]. This report discusses the effectiveness and problems of the stent, referring to the cases that we have experienced.

Material and Methods

We carried out 70 PTAs or stenting on 62 patients with 65 lesions from May 1992 to November 2002. The age of the patients varied from 42 to 89 years, with a mean of 64 years; the patients were 45 males and 17 females. The sites of the stenotic lesion were in the internal carotid artery (petrous portion~supraclinoid portion) in 24 cases, the middle cerebral artery in 25 cases, the vertebral artery (V4) in seven cases, and the basilar artery in nine cases. The

degree of stenosis ranged from 70% to 99%, with a mean of 80%. Of these, stenting was carried out nine times for nine cases of nine lesions. The patients for whom stenting was carried out had an average age of 62, and were eight men, and one woman. The stenotic lesions involved the internal carotid artery (petrous portion) in four cases, the internal carotid artery (cavernous portion) in two cases, the internal carotid artery (supraclinoid portion) in one case, the middle cerebral artery (M1) in one case, and the vertebral artery (V4) in one case. The degree of stenosis ranged from 70% to 99%, with a mean of 80%. We considered that symptomatic lesions, such as TIA and minor stroke, which present 70% or more of the degree of stenosis, were indications of circulation reconstruction. Furthermore, we considered cases in which cerebral blood flow examination shows a decrease in cerebral blood flow in the area supplied by the pathological vessel to be an indication for treatment.

Endovascular treatment was chosen as a result of informed consent, and was sufficient in all cases. Preoperative angiography was fully considered, and pathological changes that can extend a narrowed area using a STEALTH balloon angioplasty catheter or coronary balloon angioplasty was applicable. First, under local anesthesia, a 6F or 7F introducer was held at the femoral artery using the Seldinger method, and we reached the pathological vessel from this point. Recently, we have used general anesthesia so that the patient does not move at all during treatment. By introducing general anesthesia, the positioning of the balloon catheter or stent using the road map function is very precise, and we could deal promptly with complications that suddenly occur during the operation. During the operation, the patients were fully heparinized using ACT monitoring. The guidewire was sufficiently advanced from the stenosis to the distal and the balloon catheter for PTA or stent was carried forward along this guidewire, and it was held in the pathological lesion. To prevent vascular rupture at the time of dilatation, the vessel diameter in front of and behind the stenosis was correctly measured before PTA was carried out. The balloon was inflated to a little smaller than the measured value, and the size of the stent was chosen as this value. Only the balloon catheter was pulled up from the lesion, leaving the guidewire in place, after judging that sufficient vascular dilatation was obtained following PTA. Angiography was performed after about 10 minutes, and whether reocclusion would occur was checked. Furthermore, the guidewire was pulled up from the lesion, and angiography was carried out after ten minutes. If reocclusion did not occur, we finished the treatment. After finishing the operation, continuous intravenous injection of heparin was carried out for 24 hours. In addition, the anti-platelet agent taken preoperatively was continuously administered to the patient.

Results

On angiography, PTA was successfully performed 56 times out of 70 times, and the initial success rate was 80%. After PTA, when the residual stenosis reached 50% or less, we considered that it was successful. Although the preoperative degree of stenosis was 70% to 99% (a mean of 80%), it improved 0% to 50% (a mean of 25%) after the operation. PTA was not successful 14 times. The causes were one peripheral embolism, four insufficient dilatations, three subarachnoid haemorrhages, and six dissections. After the operation, symptomatic complications occurred with 5 PTAs (7.1%) out 70. The causes of the symptomatic complications that occurred were three cerebral infarctions and two subarachnoid haemorrhages. There was one death (1.4%) out of 70 due to subarachnoid haemorrhage being produced because of the rupture of an aneurysm that was present before undergoing the operation. There were four major complications (5.7%) that resulted in major stroke. Clinical follow-up was carried out over an average of 46 months, for a maximum of 96 months. Five patients died of cardiac infarction or pneumonia. There were three cerebral infarctions produced in the part at which PTA was carried out, and there were two cerebral infarctions that were unrelated to the part at which PTA was performed. Symptoms of cerebral infarction developed in five patients over an average of 46 months, and the incidence was 3.6% every year. Angiographic follow-up was performed for 40 patients after 56 successful PTA procedures. There were eight cases of restenosis, and obstruction was recognized in two of these cases. The appearance of neurologic symptoms was recognized in one patient in whom restenosis

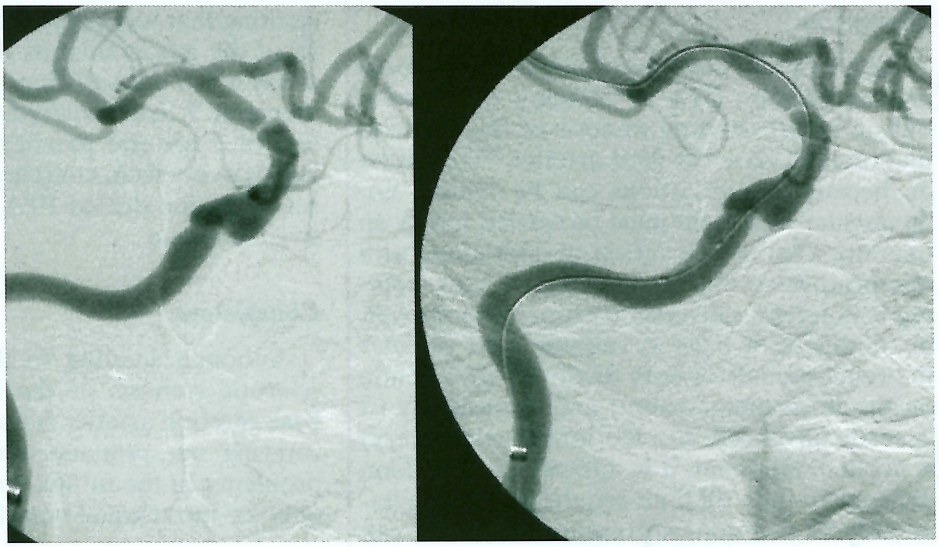

Figure 1
R.CAG,
A) Stenosis was recognized in the intracranial internal carotid artery (supraclinoid portion).
B) The intracranial internal carotid artery after PTA was imaged. The stenosis has not improved.

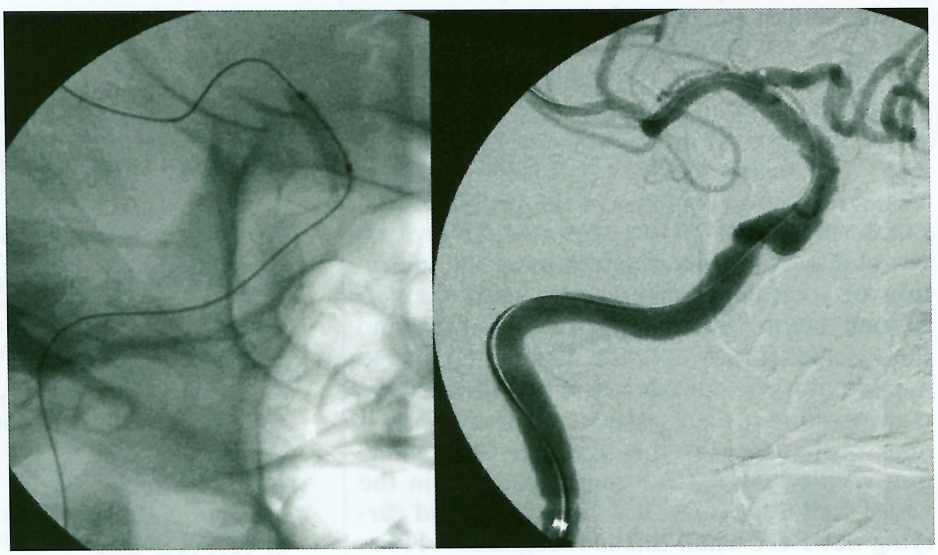

Figure 2
A) The stent (S670; 3.5 mm x 10 mm) was put on the stenosis.
B) The stenosis was dilated after stenting.

occurred. For one patient, PTA was carried out again. Stenting was performed for four patients whose dilatation of stenosis was insufficient, and for five patients for whom dissection was conducted, after PTA was performed. Stenting was successfully performed for nine patients, and the stenosis was fully inflated. Postoperative complications occurred in three patients. There was one case of major deficit because the vessel was perforated by the guidewire, and subarachnoid haemorrhage occurred. There was one case of asymptomatic cerebral infarction due to distal embolism occurring during the operation. There was one case of obstruction of the lesion where stenting was carried out three months after performing the operation, but there were no symptoms.

Representative Patient

The patient was a 68-year-old male, and because of repeated transient ischemic attacks, he was referred to our hospital. In angiography, stenosis was recognized in the right intracranial internal carotid artery (figure 1). Circulation reconstruction was performed after informed consent was obtained. First, although PTA was performed, sufficient vascular dilatation was not obtained. Therefore, the stenosis was fully dilated using a stent (figure 2).

Discussion

With improvement in treatment equipment and technology, PTA or stenting was carried out on atherosclerotic stenosis of the intracranial or skull base cerebral arteries [1-8,10]. However, because complications can be critical, endovascular treatment must be carried out by an operator who is well versed in operations with microcatheters. For this reason, PTA or stenting is not yet a universal treatment. Moreover, in treatment, a balloon catheter that satisfies the requirements of both flexibility (it is gentle on the intracranial artery) and accessibility (it is easily advanced into the intracranial artery) is needed. However, it is difficult for a balloon catheter to fully fill both requirements simultaneously. In addition, at present, a stent that can pass easily through areas with sharp bends such as the siphon portion of the internal carotid artery has not yet been obtained. Currently, if it is used for treatment, the balloon catheter and stent that are used for atherosclerotic stenosis of the intracranial or skull base cerebral arteries is an excellent device for coronary arteries. Vessel dissection is in one of the problems that can occur when PTA is performed. To prevent vessel dissection, when determining the indication of treatment, angiography must be performed before undergoing an operation, and the vascular form where the dissection tends to happen must be considered. When the stenosis is involved in a thick branch, or the stenosis is long, or the vessel wall is irregular with dissection or ulcer, dissection tends to occur in the vessel wall after PTA. It is better to avoid carrying out PTA when this is recognized [3]. However, when vessel dissection occurs after carrying out PTA, it can be avoided using a stent for this problem. For this reason, when PTA is carried out, the operator always needs to back up the stent.

In addition, if the dissection occurs, it is necessary to discuss preoperatively whether the stent can be guided to the portion that is dissected. At the time of performing PTA and stenting, another problem is that distal embolism may occur. Although there is protection system for cervical internal carotid artery stenosis [9], intracranial vascular stenosis cannot technically be prevented at present. For this reason, this problem must also be discussed in the future. With our cases, there was 1 case of vascular occlusion after stenting. Thus, since stenting that is applied to atherosclerotic stenosis of the intracranial or skull base cerebral arteries is not yet sufficient and the target vessel diameter is narrow, there is the current problem of long-term patency. However, considering recovery from complications, especially vessel dissection due to PTA, stenting is an effective technique.

Conclusions

Although stenting to the inside of atherosclerotic stenosis of the intracranial or skull base cerebral arteries is useful in assisting PTA, carrying out primary stenting still has many problems. In the future, development of a stent only for intracranial vessels is expected.

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